NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF:

October 15, 1970

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned
U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,298,285

Corporate Source : Calif. Institute of Technology

Supplementary
Corporate Source : Jet Propulsion Laboratory

NASA Patent Case No.: XNP-01962

Please note that this patent covers an invention made by an employee of a NASA contractor. Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of. . . ."

Gayle Parker

Enclosure:
Copy of Patent

Jan. 17, 1967 JAMES E. WEBB 3,298,285
ADMINISTRATOR OF THE NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
REINFORCING MEANS FOR DIAPHRAGMS
Filed May 22, 1964

N70-41370

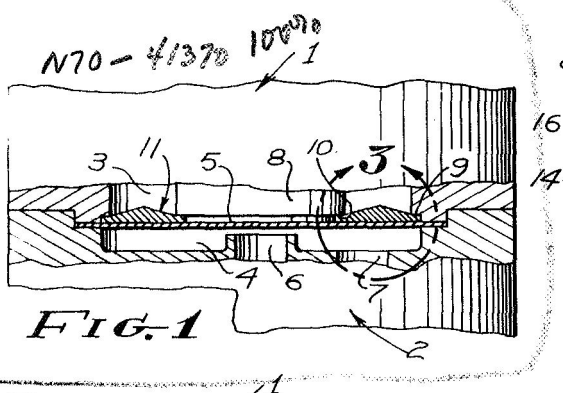

FIG. 1

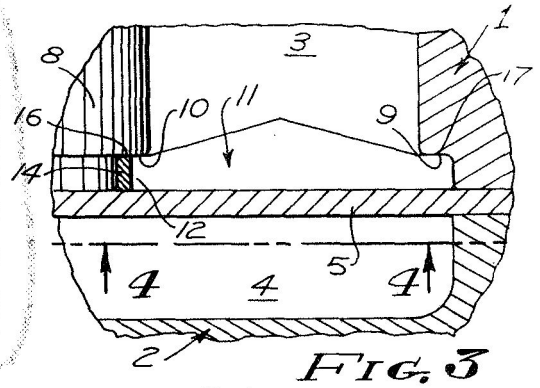

FIG. 3

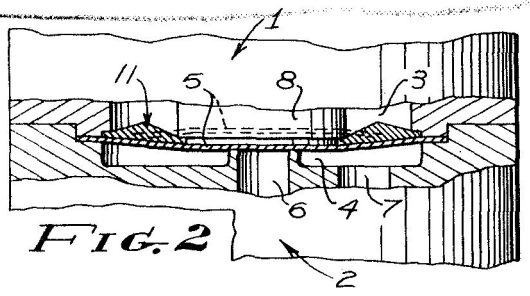

FIG. 2

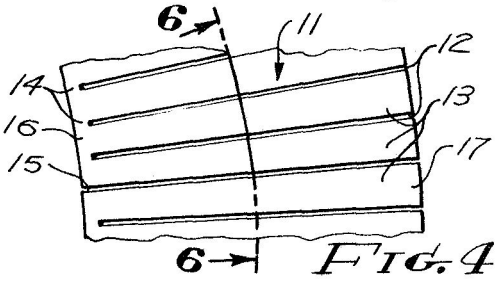

FIG. 4

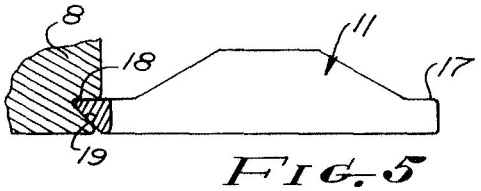

FIG. 5

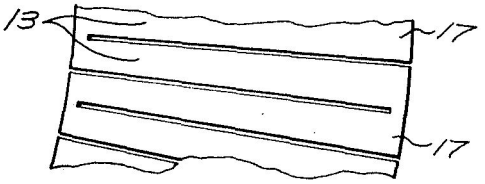

FIG. 4A

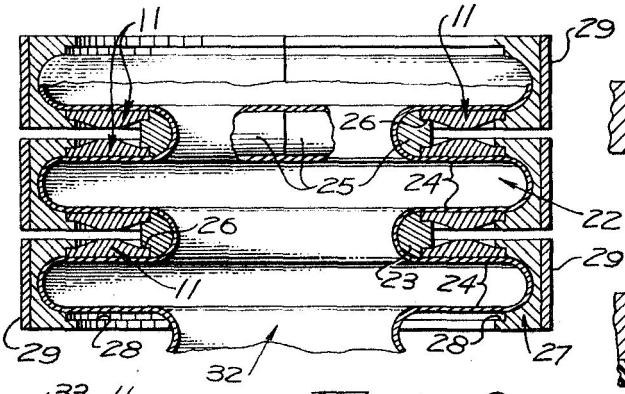

FIG. 8

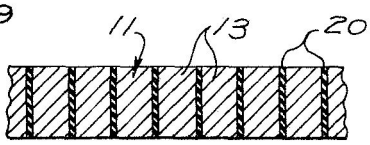

FIG. 6

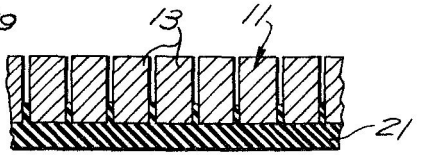

FIG. 7

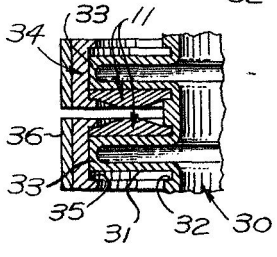

FIG. 9

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3,298,285

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3,298,285

REINFORCING MEANS FOR DIAPHRAGMS

James E. Webb, Administrator of the National Aeronautics and Space Administration with respect to an invention of William F. MacGlashan, Jr.

Filed May 22, 1964, Ser. No. 369,640
3 Claims. (Cl. 92—94)

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85–568 (72 Stat. 435; 52 U.S.C. 2457).

This invention relates to reinforcing means for diaphragms, and included in the objects of this invention are:

First, to provide a reinforcing means for diaphragms which is adapted to permit use of highly flexible diaphragms sensitive to minor changes in pressure under conditions wherein the pressure differential across the diaphragms may, by accident or design, be extremely high, in the range of several thousand pounds; this being accomplished without impairing the future function of the diaphragm.

Second, to provide a reinforcing means for diaphragms which has a wide range of applications, including, but not limited to, line valves, pressure regulators, pressure switches, and bellows such as used for flexible seals or connections.

Third, to provide a reinforcing means for diaphragms which employs a novelly arranged ring of bridging beams underlying the flexing portion of the diaphragm, and providing full support therefor without impairing the flexibility of the diaphragm.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

FIG. 1 is a fragmentary view showing one form of the reinforcing means for diaphragms incorporated in a valve structure, and showing the diaphragm in its flat or normal condition;

FIG. 2 is a similar fragmentary view showing the diaphragm and its support by solid lines in one extreme displaced position, and by dotted lines in an opposite extreme displaced position;

FIG. 3 is an enlarged, fragmentary sectional view taken within circle 3 of FIG. 1;

FIG. 4 is an enlarged, fragmentary view of the bridging ring taken in the direction of 4—4 of FIG. 3, the overlying diaphragm being omitted;

FIG. 4A is a fragmentary view similar to FIG. 4 showing a modified form of the bridging ring;

FIG. 5 is a fragmentary sectional view similar to FIG. 3 showing a modified form of the bridging ring;

FIG. 6 is a sectional view taken substantially through 6—6 of FIG. 4 but showing a modified form of the bridging ring;

FIG. 7 is a similar sectional view showing a further modified form of the bridging ring wherein the diaphragm formed of elastomer is bonded to the bridging ring;

FIG. 8 is a fragmentary sectional view of a bellows, the diaphragms of which are supported by the reinforcing means;

FIG. 9 is a fragmentary sectional view showing another type of bellows wherein the diaphragm elements are supported by the reinforcing means.

The structure in which the diaphragm and its reinforcing means may be mounted may be any one of several types of valves, such as line valves or regular valves, or the structure may be a pressure-sensitive device such as a pressure switch.

In any case, however, such structure includes a pair

of body members 1 and 2 having confronting recesses 3 and 4 bordered by clamping faces between which is clamped the periphery of a diaphragm 5. In the structure illustrated in FIGS. 1 and 2, the body members 1 and 2 are indicated as forming portions of a valve which includes an inlet 6 and an outlet 7 communicating with the recess 4.

Located within the recess 3 on the opposite side of the diaphragm from the recess 4 is a mandrel 8 capable of axial movement within the recess 3. The periphery of the recess 3 adjacent the clamped margin of the diaphragm 5 is provided with a shoulder 9 confronting but spaced from the diaphragm. Similarly, the mandrel 8 is provided with a shoulder 10 confronting but spaced from the diaphragm 5. The annular region of the diaphragm between the shoulders 9 and 10 forms the active or displaceable portion of the diaphragm.

Fitted between the shoulders 9 and 10 is a bridging ring 11 which is provided with a plurality of radial slits 12 so as to form therebetween a plurality of bridging beams 13. The radial slits 12 preferably do not extend entirely through the bridging ring 11, but stop short of the inner periphery thereof so as to form narrow webs 14 joining adjacent bridging beams 13. In some instances it is desirable to slit the bridging ring 11 or to divide the bridging ring into one or more segments. In this case a slit 15 continues from a selected slit 12 through the web 14 as indicated in FIG. 4. Also the slits 12 may extend alternately from the radially inner and radially outer peripheries of the bridging ring 11, forming alternate webs 14 and 14*a* as shown in FIG. 4A.

The radially inner extremity of each bridging beam 13 rests on the shoulder 10 and forms a bearing face 16 capable of limited, pivotal or tilted movement relative to the shoulder 10. Similarly, the radially outer extremity of each beam 13 is provided with a bearing face 17 which rests on the shoulder 9. Between the bearing surfaces 16 and 17 the bridging beams 13 increase in depth toward their central portions.

The side of each bridging beam 13 is flat and in confronting and supporting relation to the diaphragm 5; that is, the diaphragm is supported by the surfaces of the ring 11 of the bridging beams 13. The width of the slots 12 between these surfaces constitute only a small fraction of the thickness of the diaphragm 5.

Operation of the reinforcing means for diaphragms is as follows:

The bridging ring 11 may deflect by relative axial displacement of the bearing faces 16 and 17 as indicated in FIGS. 1 and 2. Such deflection requires no appreciable energy. By reason of the narrow width of the slits 12, a relatively thin diaphragm 5 may overlie the bridging ring 11.

A thin diaphragm 5 offers low resistance to axial displacement of the central portion of the diaphragm 5, As a consequence the diaphragm 5 backed by the bridging ring 11 is quite sensitive to relatively slight changes in pressure. However, should the pressure across the diaphragm 5, by design or accident, become enormous, that is, in the range of several thousand pounds, the diaphragm 5 supported by its bridging ring 11 may withstand such pressure differentials without injury.

Reference is directed to FIG. 5. It is sometimes desirable that the inner or outer periphery of the bridging ring 11 be retained with respect to its corresponding supporting member. This may be accomplished by beveling the webbed margin of the bridging ring 11 as indicated by 18, and the corresponding shoulder may form one side of a V-groove 19. In this case the bridging ring 11 is split in one or more places so that the beveled margin may be fitted into the V-groove 19.

In some instances it is desirable to bond the bridging beams **13** or segments of the bridging ring **11** to each other by means of an elastomer **20** as shown in FIG. 6. The elastomer may completely fill the slits **12** or may be in the form of a thin coating on either or both sides of the bridging ring **11** so as to enter a superficial distance into the radial slits **12**. In the latter case the freedom of movement of the bridging ring **11** is not appreciably changed. If, however, the elastomer **20** completely fills the slits **12**, the stiffening of the bridging ring **11** is of course increased.

In some instances, as shown in FIG. 7, a diaphragm **21** corresponding to the diaphragm **5** may be bonded to the lower surface of the bridging ring **11** and penetrate any desired depth from a superficial distance to the full depth of the bridging beams **13**. Still further, the metal diaphragm **5** may be bonded to the surface of the bridging ring **11** by solder or adhesive such as an epoxy resin.

The benefits of the reinforcing means for diaphragms is not limited to essentially flat diaphragms but may be employed to strengthen bellows-type diaphragms. In this case each radial portion of the bellows may be considered as a diaphragm element. In this respect reference is directed to FIG. 8 in which is illustrated a bellows **22** having external annular channels **23**, the opposite sides of which form annular diaphragms **24**.

The bottom portions of the channels **23** receive internal supporting rings **25** which are spit to facilitate insertion. These rings have shoulders **26** corresponding to the shoulders **9** of the first described structure. A pair of bridging rings **11** spit for assembly extend radially outward from each internal supporting ring **25** with their outer surfaces in supporting relation with the diaphragms **24**.

A series of external supporting rings **27**, which are also split, bridge between external channels **23** and are provided with shoulders **28** corresponding to the shoulders **10** for supporting the radially outer margins of the bridging beams **13** forming the elements of the bridging ring **11**.

The external supporting rings **27** are encircled by bands **29** which resist outward displacement of the external supporting rings **27**, the bridging rings **11**, and the internal supporting rings **25**. With this arrangement the sensitivity of the bellows is not appreciably changed; yet if the ends of the bellows are constrained, the internal forces of the bellows may be extremely high without damage to the bellows.

Reference is directed to FIG. 9. The reinforcing means lends itself to use with a machined-type bellows **30** having external channels **31** at the inner extremities which form supporting shoulders **32**. Overlying hollow flanges **33** between the external channels **31** are external split supporting rings **34** corresponding to the rings **27** and are provided with shoulders **35** corresponding to the shoulders **26** and **10**. Also the supporting rings **34** are surrounded by constraining bands **36**. Bridging rings **11** extend between the shoulders **32** and **35**.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the exact details of the constructions set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

What is claimed is:

1. The combination with a diaphragm having an annular flexure portion of a reinforcing means comprising:

(a) a ring of radiating beam elements disposed in supporting relation to said annular flexure portion and separated, at least in part, by radial slits;

(b) a first supporting means encircling the radially outer extremities of said beam elements and forming a pivotal support therefor;

(c) and a second supporting means within the radially inner extremities of said beam elements and forming a second pivotal support therefor;

(d) one of said supporting means being displaceable relative to the other in response to a pressure differential across said diaphragm;

(e) and an elastomer connecting said beam elements to maintain said beam elements in spaced relation.

2. The combination with a diaphragm having an annular flexure portion, of a reinforcing means comprising:

(a) a supporting ring having a plurality of equally spaced radiating slits, partially severing said ring and some of said slits fully severing said ring into a plurality of attached beam elements, each beam element being of constant cross section in a transverse direction, increasing in thickness from its inner periphery and its outer periphery toward a point midway therebetween;

(b) a first supporting means encircling the radially outer extremities of said beam elements and forming a pivotal support therefor;

(c) and a second supporting means within the radially inner extremities of said beam elements and forming a second pivotal support therefor;

(d) one of said supporting means being displaceable relative to the other in response to a pressure differential across said diaphragm.

3. A diaphragm reinforcing means as set forth in claim **2**, wherein:

(a) said slits are at least partially filled with an elastomer.

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